


MEMORANDUM

DATE: March 10, 2014

TO: Mr. Robert Walker
Walker Realty, LLC
2 Lan Drive
Westford, MA 01886

FROM: Robert J. Michaud, P.E. – Managing Principal
Courtney E. Jones, E.I.T. – Transportation Engineer 

RE: Updated Traffic Impact Assessment
Proposed Next Generation Children's Center & Landscape Center
348, 350, 352, 362 & 364 Main Street – Acton, Massachusetts

MDM Transportation Consultants, Inc. (MDM) has prepared this updated traffic impact assessment (TIA) for the proposed 21,300± square-foot Next Generation Children's Center (NGCC) to be located at 348-354 Main Street in Acton, Massachusetts. This memorandum provides an updated traffic analysis for the proposed daycare facility relative to the previously submitted July 2008 TIA¹ prepared for the project. Specifically, this memorandum describes updated existing (baseline) traffic conditions for adjacent roadways, trip generation characteristics of the proposed development, quantifies incremental traffic impacts of the site development on area roadways, and evaluates safety-related conditions at key study locations that provide access to the site.

Key findings of the preliminary traffic assessment are as follows:

- *Existing Traffic Characteristics.* Main Street (Route 27), an urban other principal arterial roadway in the study area, carries approximately 16,465 vehicles per day with peak hour volumes of approximately 1,535 vehicles per hour or less. Comparison of seasonally-adjusted peak hour traffic volumes for February 2014 to seasonally-adjusted May 2008 traffic volumes indicates nearly identical traffic conditions. The critical analysis period (the period of highest roadway volume) is the weekday evening peak hour.
- *Traffic Generation.* Empirical information provided by the NGCC indicates that the site may generate approximately 130 total vehicle-trips (65 entering and 65 exiting) during

¹ *Traffic Impact Assessment, Proposed Next Generation Children's Center, 348, 350 & 352 Main Street – Acton, Massachusetts*, prepared by MDM Transportation Consultants, Inc.; dated July 18, 2008.

peak activity periods (morning drop-off and evening pick-up). Employee-related trips will predominately occur before 7 AM and after 6 PM – hours outside the typical commuter peak hours. Additionally, NGCC anticipates sibling enrollment of approximately 20 percent and students of employees to be approximately 5%, consistent with its other facilities in Massachusetts – characteristics that are likely to further reduce vehicle generation.

To present a conservative analysis scenario, potential site trip activity was also evaluated using ITE standard industry trip rates for day care facilities. On this basis, the proposed child-care facility is estimated to generate approximately 210 new vehicle trips (111 entering and 99 exiting) during the weekday morning peak hour and 212 new vehicle trips (100 entering and 112 exiting) during the weekday evening peak hour. ITE-based trip generation estimates for the proposed development are conservatively higher than anticipated based on actual operating experience of NGCC facilities, and therefore, present a “worst case” analysis scenario for design purposes.

- *Adequate Roadway Capacity.* Adequate capacity is available along Main Street (Route 27) to accommodate projected traffic increases for the proposed development, assuming either trip generation methodology (empirical or ITE-based) described above.

The proposed South Site Driveway at Isaac Davis Way will operate below capacity at LOS C or better operations during the morning and evening peak hours. The Proposed North Site Driveway will operate below capacity (LOS E) under weekday morning peak hour conditions. During weekday evening peak hours, the North Driveway is calculated to sustain delays exiting the Site of 50 seconds or greater. However, observation of actual left-turn delays are substantially lower and these delays are attributable to only a modest volume of left-turns from the proposed Site northerly site driveway (approximately 1 vehicle per every two minutes or less). Delays and associated queues will be managed on-site with no material impact to site parking or circulation.

- *Adequate Sight Lines.* Review of sight lines at the site driveways, indicates that safe stopping sight distance (SSD) is available for oncoming vehicles to detect, react and stop for vehicles exiting onto Main Street based on regulatory speed limits and measured average and 85th percentile travel speeds. Intersection Sight Distance (ISD) criteria, which are apply to driver convenience exiting the site driveway are also met. MDM recommends that plantings (shrubs, bushes) and structures (walls, fences, etc.) be maintained at a height of 2 feet or less within the Main Street (Route 27) layout in the vicinity of the site driveways to provide unobstructed sight lines.

PROJECT DESCRIPTION

The project site is an approximate 4.7-acre tract of land (5 lots), located at 348, 350, 352, 362 and 364 Main Street (Route 27) in Acton, Massachusetts. The location of the site relative to adjacent roadways is shown in **Figure 1**. Isaac Davis Way, an existing private roadway, currently services the property via Main Street (Route 27). A metal chain across Isaac Davis Way approximately 100 feet north of Main Street (Route 27) will continue to restrict vehicle flow between the site and Hayward Road via Isaac Davis Way. NGCC will widen the existing driveway servicing its site at Isaac Davis Way.

Under the proposed development plan, the NGCC site will be developed to accommodate an approximate 21,300± sf building supported by 91 parking spaces. The NGCC facility will accommodate a maximum student enrollment of 262 children and approximately 64 staff, though initial enrollment is likely to be lower as programming is initiated and the NGCC services are marketed. The vast majority of staff is scheduled to arrive prior to the 7 AM program start time and will depart after the 6 PM program end time. Student arrivals are to be scheduled over a 3-hour period in the morning and evening to reduce vehicle impacts and parking demands, consistent with other NGCC facilities. The site will be served by two full access driveways: a full-access driveway in the northern end of the site and a curb cut at the existing Isaac Davis Way. The preliminary site layout prepared by Hancock Associates is presented in **Figure 2**.

As part of the development, the existing seasonally operated landscaping/garden center at 362 and 364 Main Street will be relocated to the southern portion of the proposed site to accommodate the construction of the NGCC facility. No change in land use or operations is anticipated as part of the relocation. The landscaping center will be separated from the proposed NGCC facility and will be served by its own driveway along Main Street and its own 15-space parking field. The analysis assumes restriction of the driveway to right-in/right-out operation, subject to MassDOT review and approval.

EXISTING ROADWAY CHARACTERISTICS

An overview of roadway classification and geometric characteristics is provided below for study roadways and intersections.

Roadways

Main Street (Route 27)

Main Street (Route 27) is generally a north-south roadway under local (Town) jurisdiction except at the Route 2 on/off ramps where Route 27 is under State (MassDOT) jurisdiction. Main Street (Route 27) is classified by the Massachusetts Department of Transportation (MassDOT) as an Urban Other Principal Arterial roadway and provides one travel lane in each direction and a paved shoulder and varies between 25 and 44 feet in the project area. Main

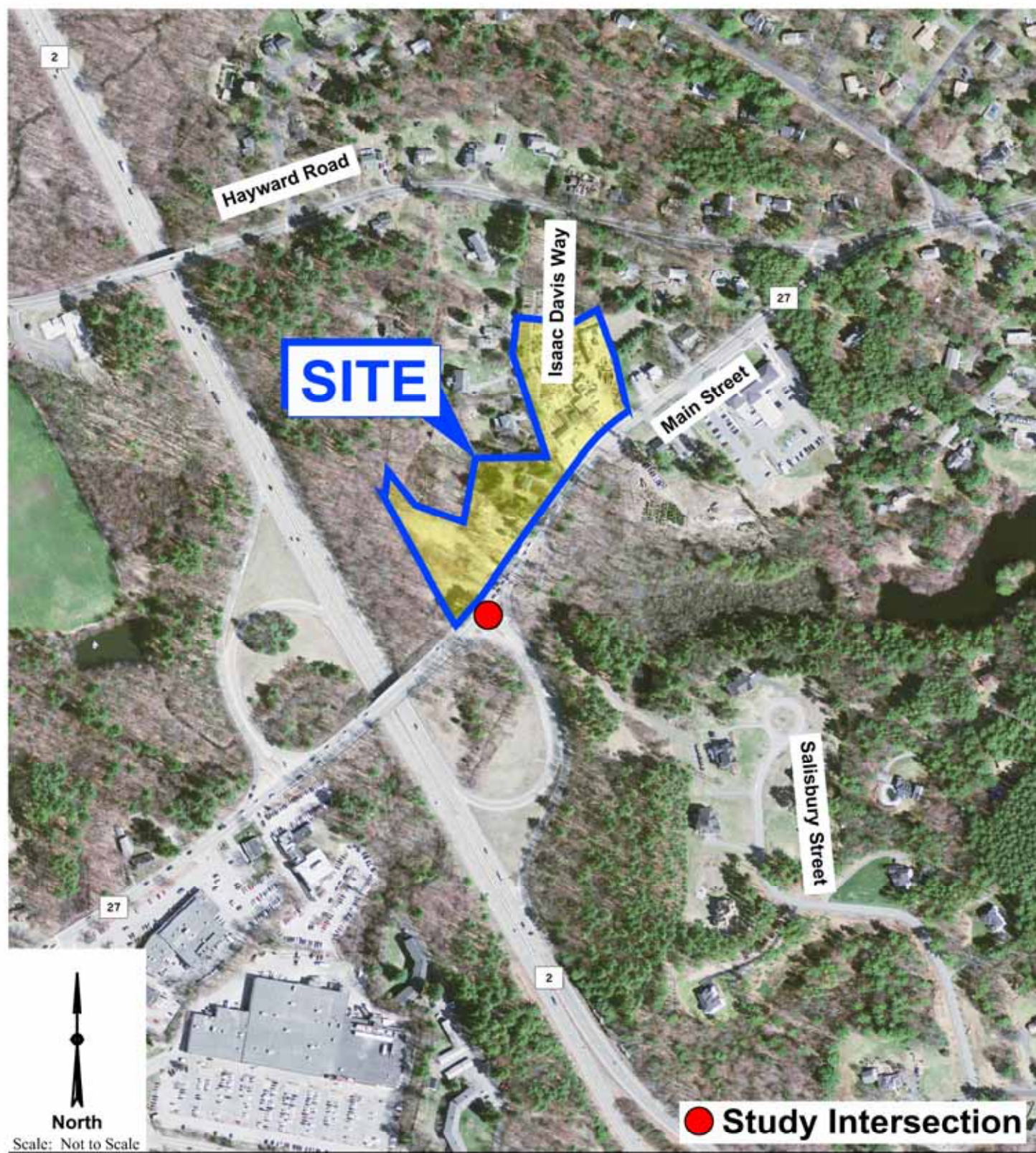
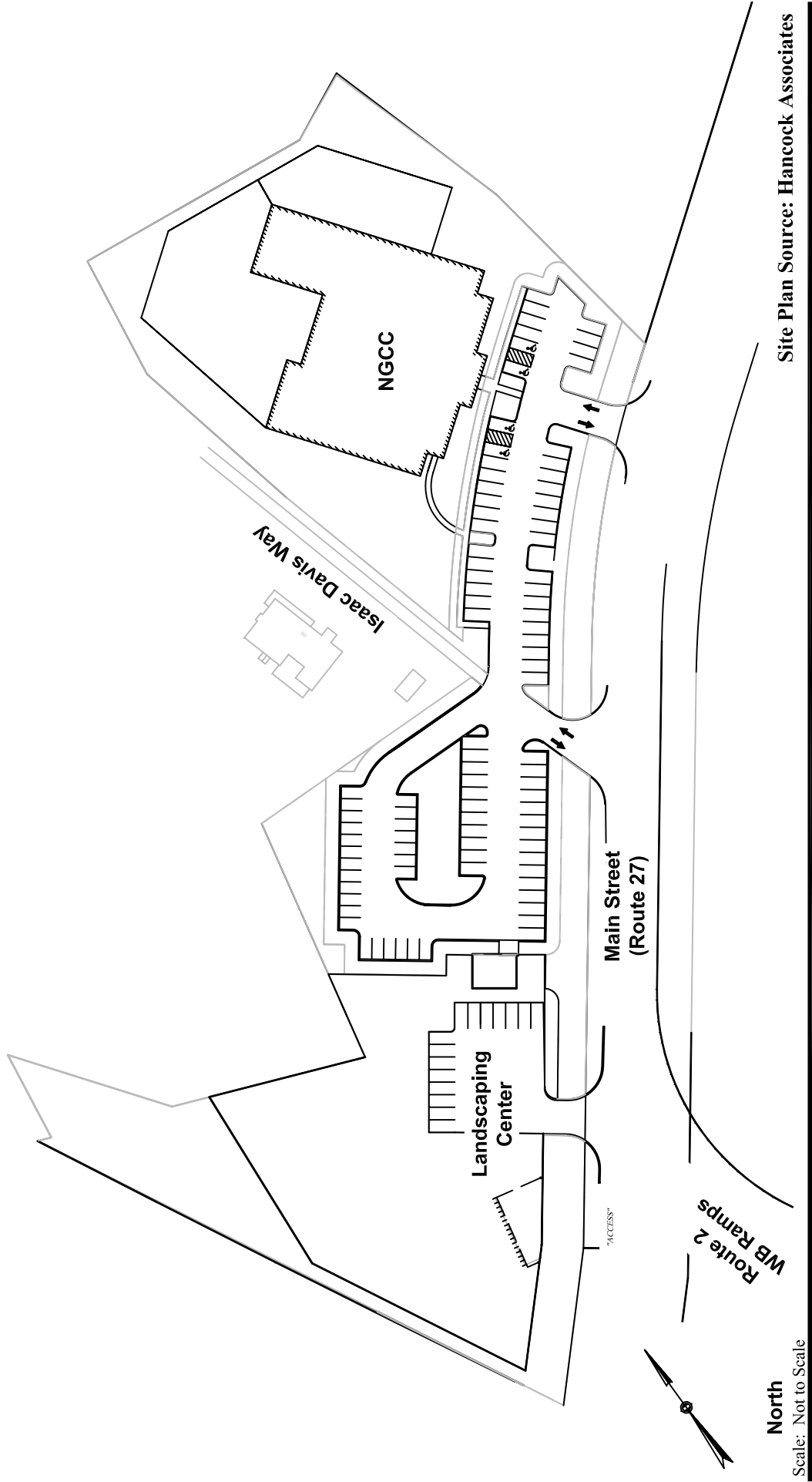


Figure 1

Site Location



North
Scale: Not to Scale

Site Plan Source: Hancock Associates

Figure 2

Preliminary Site Plan

Street (Route 27) provides a connection between Acton and the Towns of Maynard and Carlisle. The posted (regulatory) speed limit of along Main Street (Route 27) in the area is 30 miles per hour (mph) to the south of the Route 2 Eastbound on/off ramps and 35 mph to the north of the Route 2 Eastbound on/off ramps. Bituminous sidewalk is located on the western side of Main Street (Route 27) from a point south of the Route 2 Eastbound on/off ramps through the Route 2 Westbound on/off ramp. To the north of the Route 2 Westbound on/off ramps a bituminous sidewalk is located on the eastern side of Main Street with a marked crosswalk near the ramps. Land use along Main Street (Route 27) in the study area includes residential and commercial uses that include but are not limited to Kennedy & Company (landscaping supply), a veterinary clinic and the Acton Public Safety building.

Isaac Davis Way

Isaac Davis Way is generally a north-south private roadway. Isaac Davis Way connects Hayward Road to the north and Main Street (Route 27) to the south and provides a total pavement width of between 9 and 12 feet. There is no posted (regulatory) speed limit on Isaac Davis Way. A metal chain is currently located across Isaac Davis Way just north of Main Street (Route 27), which discourages the use of said roadway via Main Street (Route 27). Land use is exclusively residential and includes approximately five (5) single family houses.

Intersections

Main Street (Route 27) at Route 2 WB on/off ramps (Exit 42)

The Route 2 WB on/off ramp (Exit 42) meets Main Street (Route 27) to form a "T"-type unsignalized intersection with the Route 2 WB off ramp operating under STOP control. The Main Street (Route 27) approaches to the intersection provide a single general-purpose travel lane in each direction. The Route 2 WB off ramp approach to the intersection operates as exclusive left-turn and right-turn lanes with right turns under "Yield" control. Land use at the intersection consists of vacant land formerly consisting of a residential home at #348 Main Street and land associated with the Route 2 Highway system.

Main Street (Route 27) at Isaac Davis Way

Isaac Davis Way (private) meets Main Street (Route 27) to form a "T"-type unsignalized intersection with Isaac Davis Way operating under STOP control. The Main Street (Route 27) approaches to the intersection provide a single general-purpose travel lane in each direction. The Isaac Davis Way approach to the intersection is currently 12 feet wide and serves as the driveway for vacant land formerly consisting of a residential home located at 352 Main Street (Route 27). Land use at the intersection consists of residential houses and the Kennedy & Company (landscaping supply) to the north.

BASELINE TRAFFIC DATA

This traffic memorandum includes evaluation of area roadways likely to sustain a measurable impact from the proposed development. The study area includes the following unsignalized intersections:

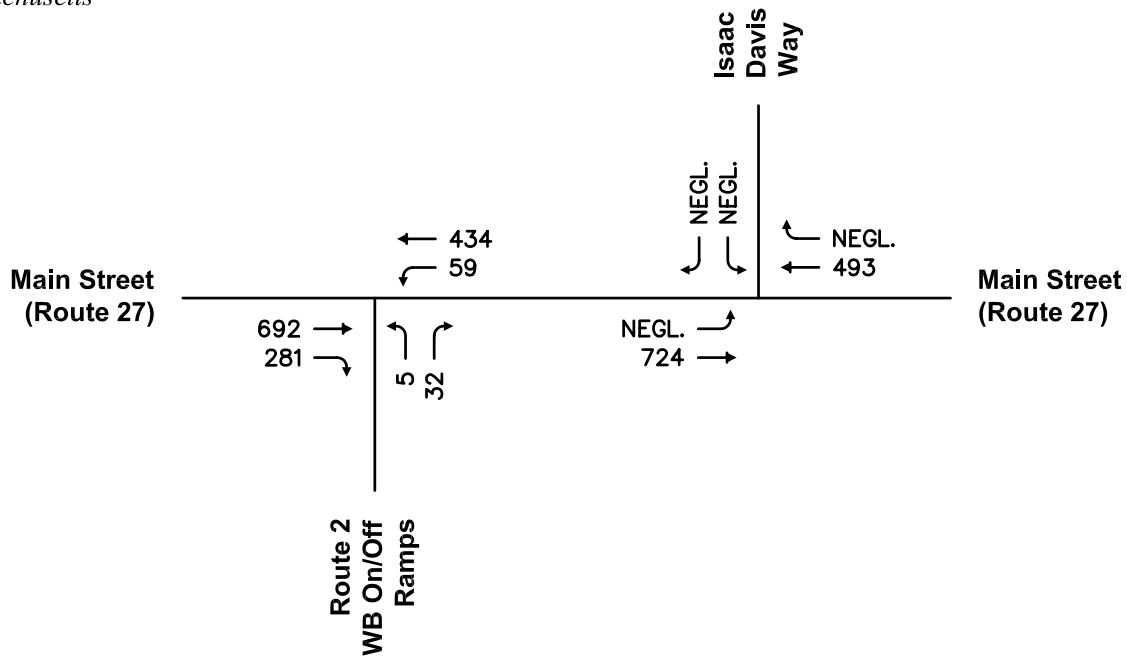
- ☐ Main Street at Route 2 WB Ramps
- ☐ Main Street at Isaac Davis Way (Site Drive South)
- ☐ Main Street at Proposed Landscaping Driveway (Kennedy Company Driveway)
- ☐ Main Street at Proposed Site Drive North

Based on review of updated traffic data for the above locations, peak hour traffic activity is nearly identical (within 1 to 2 percent) to seasonally-adjusted traffic counts collected in 2008. Accordingly, re-evaluation of operations and impacts to the Main Street at Route 2 EB Ramps is appropriately documented in the July 2008 TIA. Comparison of seasonally-adjusted traffic count data is provided in the **Attachments** for reference.

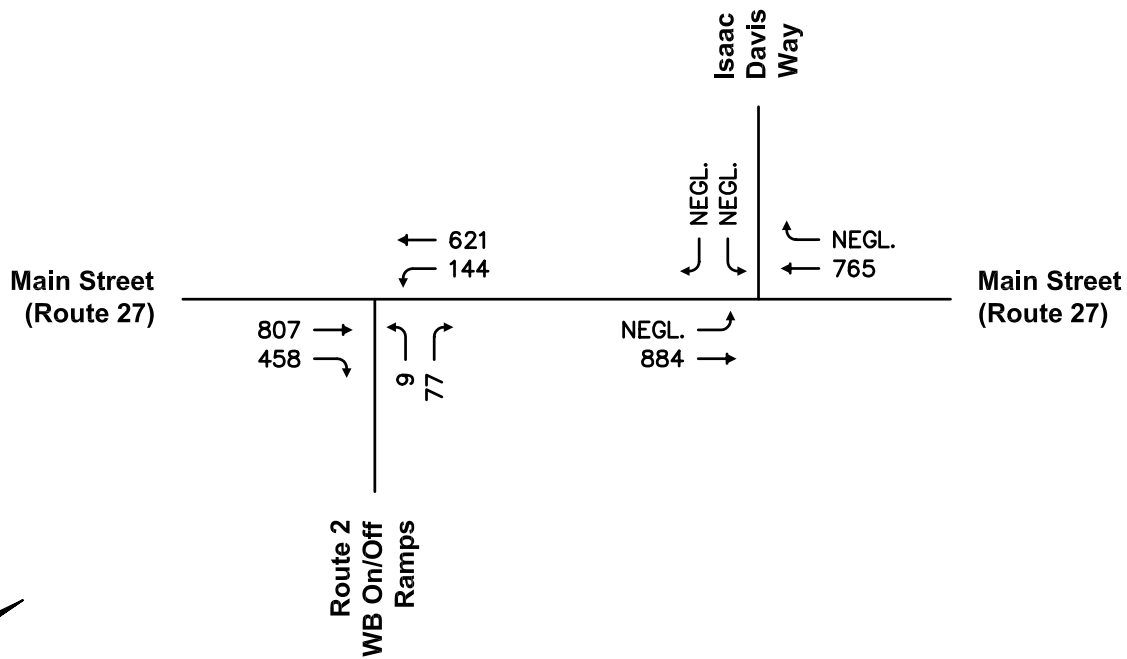
Traffic Volumes

Traffic volume data were collected at the study area intersections during the weekday morning (7:00 AM - 9:00 AM) and weekday evening (4:00 PM – 6:00 PM) periods to coincide with peak traffic activity of the proposed child-care facility use and the adjacent streets. Traffic data used in this evaluation was collected in February 2014, which represents below-average traffic conditions based on review of MassDOT permanent count station data for the area. Therefore, the observed traffic volumes were adjusted (increased) by 8 percent to represent average traffic volume conditions. An automated traffic recorder count (ATR) was also conducted in February 2014. Traffic count data and MassDOT permanent count station data are provided in the **Attachments**. The weekday morning and evening peak hours of traffic volumes for the study intersections are shown in **Figure 3**.

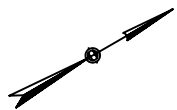
Daily traffic volumes along Main Street (Route 27) in the site vicinity were obtained by mechanical methods using a radar-based ATR in February 2014. The results of the counts are summarized in **Table 1**, and are discussed below.



Weekday Morning Peak Hour



Weekday Evening Peak Hour



North

Scale: Not to Scale

NOTES:
NEGL. = Negligible

Figure 3

**2014 Existing Condition
Peak Hour Traffic Volumes**

Table 1
EXISTING TRAFFIC VOLUME SUMMARY
MAIN STREET (ROUTE 27)

Weekday Daily Volume (vpd) ¹	Weekday AM Peak Hour			Weekday PM Peak Hour		
	Volume (vph) ²	Percent of Daily Traffic ³	Peak Flow Direction	Volume (vph)	Percent of Daily Traffic	Peak Flow Direction
16,465	1,115	7%	61% NB ⁴	1,535	9%	53% NB ⁴

¹Two-way daily traffic expressed in vehicles per day. No seasonal adjustment applied.

²Two-way peak-hour volume expressed in vehicles per hour.

³The percent of daily traffic that occurs during the peak hour.

⁴NB = northbound; SB = southbound

As summarized in **Table 1**:

- The weekday daily traffic volume on Main Street (Route 27) in the site vicinity is approximately 16,465 vehicles per day (vpd). Peak hour traffic flow on Main Street (Route 27) ranges from approximately 1,115 to 1,535 vehicles per hour (vph) representing 7 to 9 percent of daily traffic flow.
- Vehicle flow is skewed towards the northbound direction during the weekday morning peak hour and weekday evening peak hour consistent with commuter travel and the mixed-use nature of Main Street (Route 27) in the project area.

Measured Travel Speeds

Vehicle speeds were obtained for the Main Street (Route 27) northbound and southbound travel directions near the Isaac Davis Way (Site Drive South) using a radar-based ATR in February 2014. Collected speed data are provided in the **Attachments**.

Table 2
MAIN STREET (ROUTE 27) SPEED STUDY RESULTS

Travel Direction	Posted Speed Limit	Travel Speed	
		Average ¹	85 th Percentile ²
Northbound	35	34	38
Southbound	35	34	38

¹Arithmetic Mean.

²The speed at or below which 85 percent of the vehicles are traveling.

As summarized in **Table 2**, the mean (average) travel speed on Main Street (Route 27) traveling northbound and southbound is 34 mph and the 85th percentile travel speed is 38 mph. The observed travel speeds are generally consistent with the posted (regulatory) speed limit of 35 mph on Main Street (Route 27) in the study area.

SIGHT LINE EVALUATION

An evaluation of sight lines was conducted to verify that minimum recommended sight distances are available to exit onto Main Street (Route 27) from the 3 proposed site driveway locations (Site Driveway North, Site Driveway South/Isaac Davis Way and the relocated Landscaping Driveway). The evaluation documents existing sight distances for vehicles exiting the site driveways with comparison to recommended guidelines for posted speed limits and measured travel speeds.

The American Association of State Highway and Transportation Officials' (AASHTO) standards² reference two types of sight distance which are relevant at the site driveway intersections with Main Street (Route 27): stopping sight distance (SSD) and intersection sight distance (ISD). Sight lines for critical vehicle movements at the Main Street (Route 27) and site driveway intersections were compared to minimum SSD and ISD for the regulatory speed limit and measured travel speeds along Main Street (Route 27) in the site vicinity.

Stopping Sight Distance

Sight distance is the length of roadway visible to the motorist to a fixed object. The minimum sight distance available on a roadway should be sufficiently long enough to enable a below-average operator, traveling at or near a regulatory speed limit, to stop safely before reaching a stationary object in its path, in this case, a vehicle exiting from the site driveways onto Main Street (Route 27). The SSD criteria are defined by AASHTO based on design and operating speeds, anticipated driver behavior and vehicle performance, as well as physical roadway conditions. SSD includes the length of roadway traveled during the perception and reaction time of a driver to an object, and the distance traveled during brake application on wet, level pavements. Adjustment factors are applied to account for roadway grades.

SSD was estimated in the field using AASHTO standards for driver's eye (3.5 feet) and object height equivalent to the taillight height of a passenger car (2.0 feet) for the northbound and southbound Main Street (Route 27) approaches to the site driveways. **Table 3** presents a summary of the available SSD for the Main Street (Route 27) roadway segment approaching the site driveways and AASHTO's recommended SSD for the posted (regulatory) 35 mph speed limit and observed average and 85th percentile travel speeds. Sight distance calculations are provided in the **Attachments**.

² A policy on Geometric Design of Highways and Streets, American Association of State Highway and Transportation Officials (AASHTO), 2011.

Table 3
Stopping Sight Distance Summary
Main Street (Route 27) Approaches to Site Driveways

Approach/ Travel Direction	Available Stopping Sight Distance	AASHTO Recommended ¹		
		Posted Speed (35 mph)	Average Travel Speed	85 th Percentile Travel Speed
Proposed Site Driveway North				
Northbound	>400 Feet	240 Feet	230 Feet	270 Feet
Southbound	>400 Feet	265 Feet	255 Feet	300 Feet
Proposed Site Driveway South/Isaac Davis Way				
Northbound	>400 Feet	250 Feet	240 Feet	280 Feet
Southbound	>400 Feet	260 Feet	250 Feet	295 Feet
Proposed Landscaping Driveway				
Northbound	>400 Feet	255 Feet	245 Feet	285 Feet
Southbound	>400 Feet	260 Feet	250 Feet	295 Feet

¹Recommended sight distance based on AASHTO, A Policy on Geometric Design of Highways and Streets. Based on driver height of eye of 3.5 feet to object height of 2.0 feet and adjustments for roadway grade.

²Average Speed is 34 mph NB and 34 mph SB.

³85th Percentile travel speed is 38 mph NB and 38 mph SB

As summarized in **Table 3** analysis results indicate that the existing available sight lines exceed AASHTO's recommended SSD criteria for both travel directions along Main Street (Route 27) based on the regulatory speed limit and observed average and 85th percentile travel speeds.

Intersection Sight Distance

Clear sight lines provide sufficient sight distance for a stopped driver on a minor-road approach to depart from the intersection and enter or cross the major road. As stated under AASHTO's Intersection Sight Distance (ISD) considerations, *"...If the available sight distance for an entering ...vehicle is at least equal to the appropriate stopping sight distance for the major road, then drivers have sufficient sight distance to avoid collisions...To enhance traffic operations, intersection sight distances that exceed stopping sight distances are desirable along the major road."* AASHTO's ISD criteria are defined into several "cases". Each case depends on the type of traffic control at the intersection (e.g. no control, *Yield* sign, *Stop* sign, and signal control), and the specific vehicle maneuver in question (crossing, right- or left-turn). AASHTO Cases B1 (left turns) and B2 (right turns) from the site driveways were utilized in determining the recommended intersection sight distance summarized in **Table 4** below.

Available ISD was estimated in the field using AASHTO standards for driver's eye (3.5 feet), object height (3.5 feet) and decision point (14.5 feet from marked edge lines) for the northbound and southbound directions along Main Street (Route 27). **Table 4** presents a summary of the available ISD for the departure from the site driveways and AASHTO's recommended ISD for the regulatory speed limit and measured travel speeds.

Table 4
Intersection Sight Distance Summary
Site Driveway Departures to Main Street (Route 27)

Approach/ Travel Direction	Available Intersection Sight Distance	AASHTO Ideal ¹		
		Posted Speed (35 mph)	Average Travel Speed	85 th Percentile Travel Speed
<i>Proposed Site Driveway North</i>				
<i>Looking North</i>	>450 Feet	390 Feet	375 Feet	420 Feet
<i>Looking South</i>	>700 Feet	390 Feet	375 Feet	420 Feet
<i>Proposed Site Driveway South/Isaac Davis Way</i>				
<i>Looking North</i>	>500 Feet	390 Feet	375 Feet	420 Feet
<i>Looking South</i>	>500 Feet	390 Feet	375 Feet	420 Feet
<i>Proposed Garden Center Driveway</i>				
<i>Looking North</i> <i>(RI/RO Driveway)</i>	>500 Feet	335 Feet	325 Feet	365 Feet

¹ Ideal intersection sight distance based on AASHTO, A Policy on Geometric Design of Highways and Streets. Based on driver height of eye of 3.5 feet and adjustments for roadway grade. Assumes selective clearing of on-site structures and vegetation and on-site re-grading.

² Average Speed is 34 mph NB and 34 mph SB.

³ 85th Percentile travel speed is 38 mph NB and 38 mph SB

The results of the ISD analysis presented in **Table 4** indicate that the existing available sight lines looking north and south from the site driveways onto Main Street (Route 27) exceed the ideal recommended intersection sight line requirements from AASHTO for the posted speed limit and observed travel speeds assuming selective clearing of on-site vegetation and site re-grading. MDM recommends that plantings (shrubs, bushes) and structures (walls, fences, etc.) be maintained at a height of 2 feet or less within the Main Street (Route 27) layout in the vicinity of the site driveways to provide unobstructed sight lines.

INTERSECTION CRASH HISTORY

In order to identify crash trends and safety characteristics for study area intersections, crash data were obtained from MassDOT for the Town of Acton for the three-year period 2009 through 2011 (the most recent data currently available from MassDOT). Crash data for the study intersections is summarized in **Table 5** with detailed data provided in the **Attachments**.

Crash rates were calculated for the study intersection as reported in **Table 3**. This rate quantifies the number of crashes per million entering vehicles. MassDOT has determined the official District 3 (which includes the Town of Acton) crash rate to be 0.66 for unsignalized intersections. This rate represents MassDOT's "average" crash experience for District 3 communities and serves as a basis for comparing reported crash rates for the study intersections. Where calculated crash rates notably exceed the district average, some form of safety countermeasures may be warranted.

As summarized in **Table 5**:

- A total of thirteen (13) crashes were reported for the Main Street (Route 27) and Route 2 westbound on/off ramp intersection – approximately 4 per year - resulting in a crash rate of 0.52. The reported crashes at the intersection include 2 angle-type (15%) and 11 rear-end type (85%) collisions. The majority (92%) occurred under dry roadway conditions. The majority (69%) resulted in property damage only type accidents with approximately 46 percent occurring during the peak hours. There were no reported fatalities and no pedestrian/ bicycle related crashes at this location.
- There were no reported crashes at the Main Street (Route 27)/Isaac Davis Way intersection during the three-year study period.

In summary, the crash rate at the Main Street (Route 27) intersection with the Route 2 westbound on/off ramp is below the district-wide average for unsignalized intersections. Therefore, no safety countermeasures are warranted at this time at the study intersections.

Table 5
INTERSECTION CRASH SUMMARY
2009 THROUGH 2011¹

<u>Data Category</u>	<u>Main Street (Route 27) at Route 2 WB on/off ramps</u>
Traffic Control	Unsignalized
Crash Rate ²	0.52
MHD Dist. 3 Avg. ³	0.66
<i>Year:</i>	
2009	6
2010	4
<u>2011</u>	<u>3</u>
Total	13
<i>Type:</i>	
Angle	2
Rear-End	11
Head-On	0
Sideswipe	0
Single Vehicle Crash	0
Unknown/Other	0
<i>Severity:</i>	
P. Damage Only	9
Personal Injury	3
Fatality	0
Unknown	1
<i>Conditions:</i>	
Dry	12
Wet	1
Snow	0
Other/Unknown	0
<i>Time:</i>	
7:00 to 9:00 AM	4
4:00 to 6:00 PM	2
Rest of Day	7

¹Source: MassDOT Crash Database.

²Crashes per million entering vehicles (MEV)

³District 3 Average Crash Rate

FUTURE NO BUILD TRAFFIC CONDITIONS

Evaluation of the proposed development impacts requires the establishment of a future baseline analysis condition. This section estimates future roadway and traffic conditions with and without the proposed development. For this evaluation, a five-year planning horizon was selected consistent with standard industry practice.

To determine the impact of site-generated traffic volumes on the roadway network under future conditions, baseline traffic volumes in the study area were projected to a future year condition. Traffic volumes on the roadway network at that time, in the absence of the development (that is, the No-Build condition), includes existing traffic, new traffic due to general background traffic growth, and traffic related to specific developments by others that are currently under review at the local and/or state level. Consideration of these factors resulted in the development of No-Build traffic volumes.

The following section provides an overview of future No-Build traffic volumes.

Background Growth

Background traffic includes demand generated by other planned developments in the area as well as demand increases caused by external factors. External factors are general increases in traffic not attributable to a specific development and are determined using historical data.

Nearby permanent count station data published by MassDOT indicates a flat or declining growth rate. For purposes of this evaluation, a conservative 1 percent growth rate was used (5 percent increase over a 5-year horizon). This growth rate is higher than historic rates, and as such is also expected to account for any small fluctuation in traffic as may occur with day to day traffic volumes and traffic associated with small developments and vacancies in the area. MassDOT permanent count station data is provided in the **Attachments**.

Site-Specific Growth

Development of future No-Build traffic volumes also considers traffic generated from specific area developments. Based on review of local and State (Massachusetts Environmental Policy Act) files for the Town of Acton, there are three projects that may generate traffic through the study area:

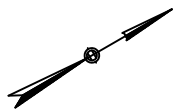
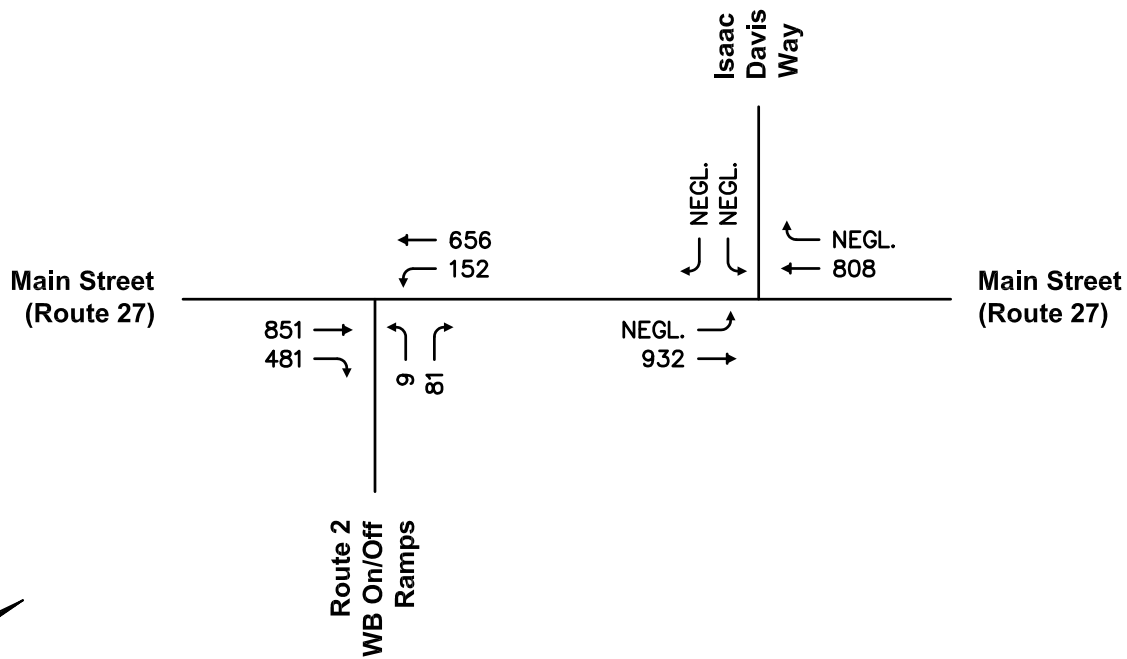
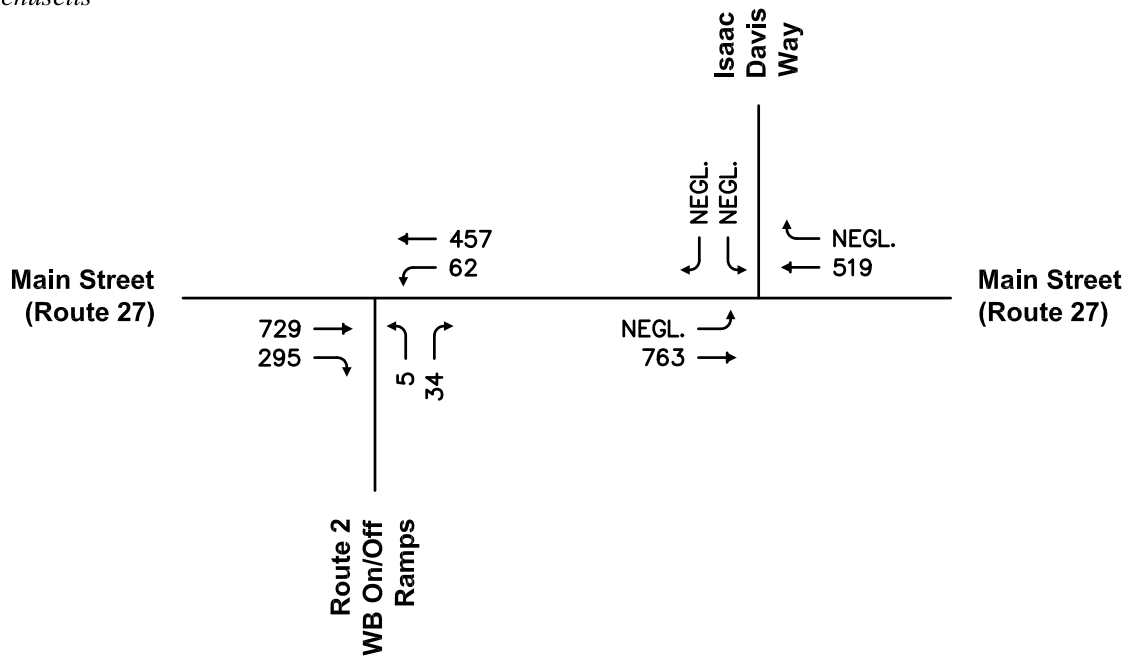
- **West Acton Village Ecology Project:** This is a mixed-use development 525-543 Massachusetts Avenue (Route 111) in Acton. Per the development's website, this project is partially completed and occupied. Given the location of the project relative to the study area and the local regional roadway network, it is assumed that traffic associated with the remaining build-out for this project will be reasonably accounted for in the background growth rate.
- **CVS Pharmacy:** CVS pharmacy plans to relocate from their existing operation at Acton Plaza II along Route 111 to a proposed stand-alone building across the street. Since this is an existing use being relocated, any additional traffic to be generated by the site as a result of the change in size is assumed to be reasonably accounted for in the background growth rate.
- **Residential 40B:** A residential 40B project consisting of 12 single-family homes is planned to be constructed in Post Office Square. Given the location of this project relative to the study area and the small number of trips anticipated to be generated, it is assumed that traffic associated with the remaining build-out for this project will be reasonably accounted for in the background growth rate.

There are also several commercial vacancies in the area including the former McDonald's building in Kelly's Corner and office/industrial vacancies in the Post Office Square area. However, traffic associated with the re-occupancy of these vacancies can be reasonably accounted for in the conservative background growth rate.

Additionally, the existing landscaping use at the site (Kennedy & Company) was not fully operational at the time the traffic counts were conducted in February 2014. Since the existing landscaping use is anticipated to remain in operation in the future, traffic associated with full operation of the landscaping center was accounted for in the No-Build traffic volumes and is based on ITE industry-standard trip rates for the most closely related land use (LUC 817 - Garden Center). Trip generation based on ITE trip rates and trip distribution calculations based on existing travel patterns are provided in the **Attachments**.

Future No-Build Traffic Volumes

Future No-Build traffic volumes are developed by increasing the existing (2014) volumes by approximately 5 percent (1 percent compounded annually over 5 years) and adding traffic associated with full operation of the existing landscaping use at the site. The resulting No-Build traffic volumes are displayed in **Figure 4**.



North

Scale: Not to Scale

NOTES:
NEGL. = Negligible

Weekday Evening Peak Hour

FUTURE BUILD TRAFFIC CONDITIONS

Future Build traffic conditions are developed by estimating additional trips associated with the proposed development, estimating likely travel patterns for these new trips and adding the resulting trips to the No-Build traffic networks. Specific methodologies and assumptions used to estimate trips and the trip distribution are discussed below.

Trip Generation

The trip generation estimates for the proposed development are provided for the weekday morning and weekday evening periods, which correspond to the critical weekday analysis periods for the proposed use and adjacent street traffic flow.

Empirical information provided by the NGCC indicates that the site may generate approximately 130 total vehicle-trips (65 entering and 65 exiting) during peak activity periods (morning drop-off and evening pick-up). Employee-related trips will predominately occur before 7 AM and after 6 PM – hours outside the typical commuter peak hours. Additionally, NGCC anticipates sibling enrollment of approximately 20 percent and 5% students of employees, consistent with its other facilities in Massachusetts – characteristics that are likely to further reduce vehicle generation. A summary of NGCC data provided by the Applicant in a July 11, 2007 letter³ is provided in the **Attachments**.

To present a conservative analysis scenario, potential site trip activity was also evaluated using ITE standard industry trip rates for day care facilities. New traffic generated by the project was estimated using trip rates published in ITE's *Trip Generation*⁴ for Land Use Codes (LUC) 365 – Day Care Center – a land use that most closely reflect the characteristics of the child-care use at the site. **Table 6** presents a summary of trip-generation estimates based on ITE industry-standard trip rates.

³ *Traffic Patterns of Next Generation Children's Centers*, prepared by Walter Kelleher, CFO-NGCC, to the Walpole Planning Board dated July, 11, 2007.

⁴ *Trip Generation*, Ninth Edition; Institute of Transportation Engineers; Washington, DC; 2012.

Table 6
TRIP-GENERATION SUMMARY

Period/Direction	Site Trips (ITE Trip Rates) ¹
<i>Weekday Morning Peak Hour</i>	
Entering	111
<u>Exiting</u>	<u>99</u>
Total	210
<i>Weekday Evening Peak Hour</i>	
Entering	100
<u>Exiting</u>	<u>112</u>
Total	212
<i>Weekday Daily</i>	1,148

Source: ITE *Trip Generation*, Ninth Edition; 2012.

¹Based on ITE LUC 565 (Day Care Center) applied to 262 students

As summarized in **Table 6**, ITE-based estimates indicate the proposed development may generate approximately 210 vehicle trips (111 entering and 99 exiting) during the weekday morning peak hour and 212 vehicle trips (100 entering and 112 exiting) during the weekday evening peak hour. On a daily basis, the proposed child-care use is estimated to generate approximately 1,148 vehicle trips on a weekday with 50 percent entering and exiting. Trip generation calculations are provided in the **Attachments**.

Table 7 presents a comparison of trip generation estimates based on ITE methodology and empirical NGCC data. As shown in **Table 7**, ITE-based trip generation estimates result in approximately 80 more peak hour vehicle-trips than traffic volumes anticipated by the Applicant. Although the trip-generation estimates provided by the Applicant are more representative of typical peak hour traffic activity for the proposed site, trip generation based on ITE methodology has been included in this assessment to present a conservative analysis.

Table 7
TRIP-GENERATION COMPARISON

Period/Direction	Site Trips (ITE-Based) ¹	Site Trips (Based on NGCC Data) ²	Difference
<i>Weekday Morning Peak Hour</i>			
Total	210	130	+80
<i>Weekday Evening Peak Hour</i>			
Total	212	130	+82

¹See Table 4.

²*Traffic Patterns of Next Generation Children's Centers*, prepared by Walter Kelleher, CFO-NGCC, to the Walpole Planning Board dated July, 11, 2007.

In summary, the ITE-based trip generation estimates presented in this traffic assessment assume a maximum occupancy level at the facility. The ITE-based estimates are very conservative relative to anticipated traffic rates based on data from similar facilities as summarized in correspondence provided by the Applicant (see **Attachments**). For comparison purposes, both trip-generation estimates are used in evaluating the potential impacts of the development.

Trip Distribution

The distribution for NGCC development-related traffic is based on existing travel patterns of the adjacent roadway system, efficiency of roadways leading to the site, and US Census Journey to Work data for the Town of Acton. Assignment of trips at Site driveways is estimated based on the proportional distribution of parking spaces at the Site and proximity of these spaces to each driveway; the **Attachments** present a calculation of these proportional trip assignments. The resulting trip distribution is presented in **Figure 5**.

Figure 6 and **Figure 7** present projected site-generated traffic volumes based on ITE trip rates and NGCC data, respectively, and projected travel patterns presented in **Figure 5**.



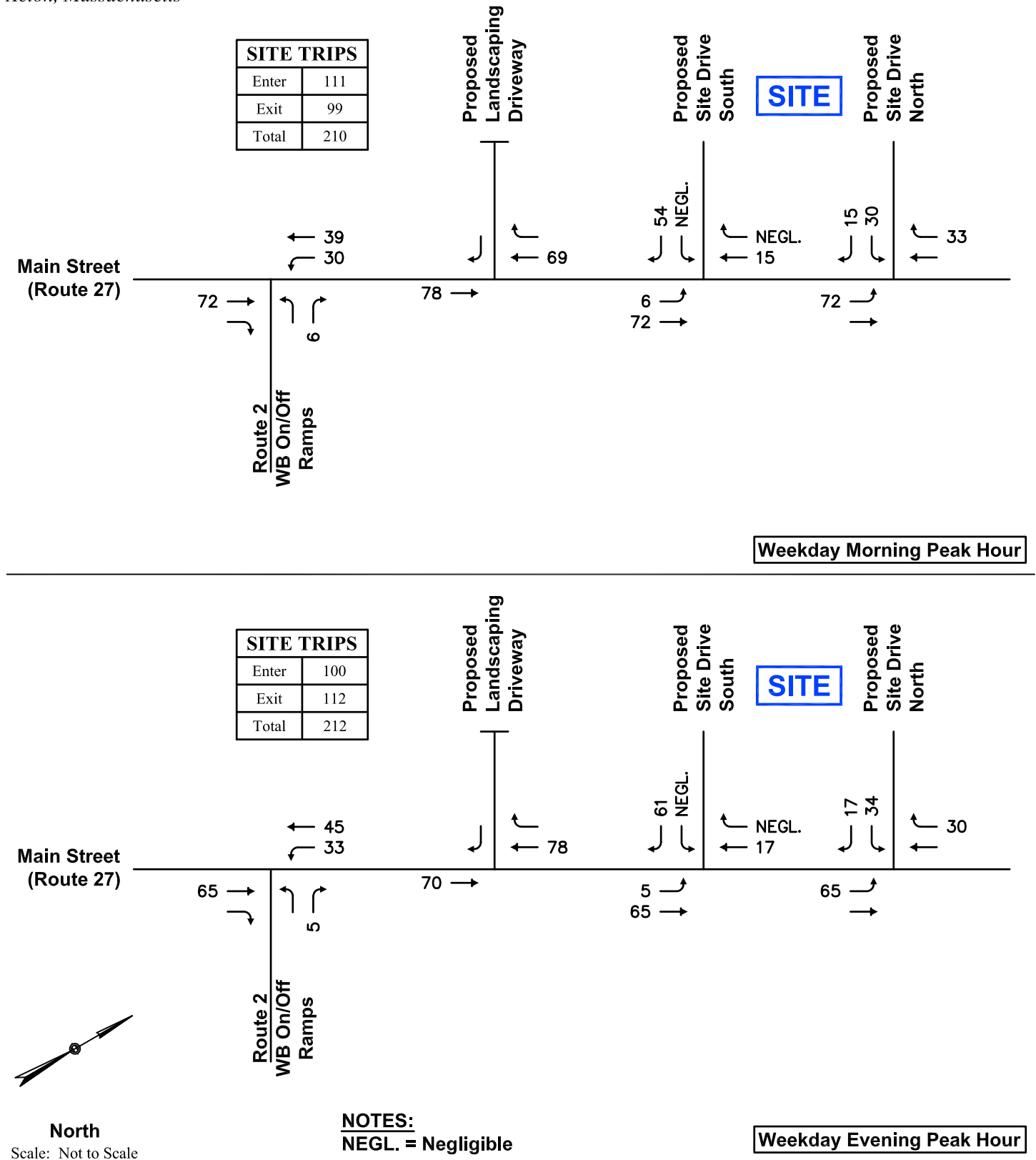


Figure 6

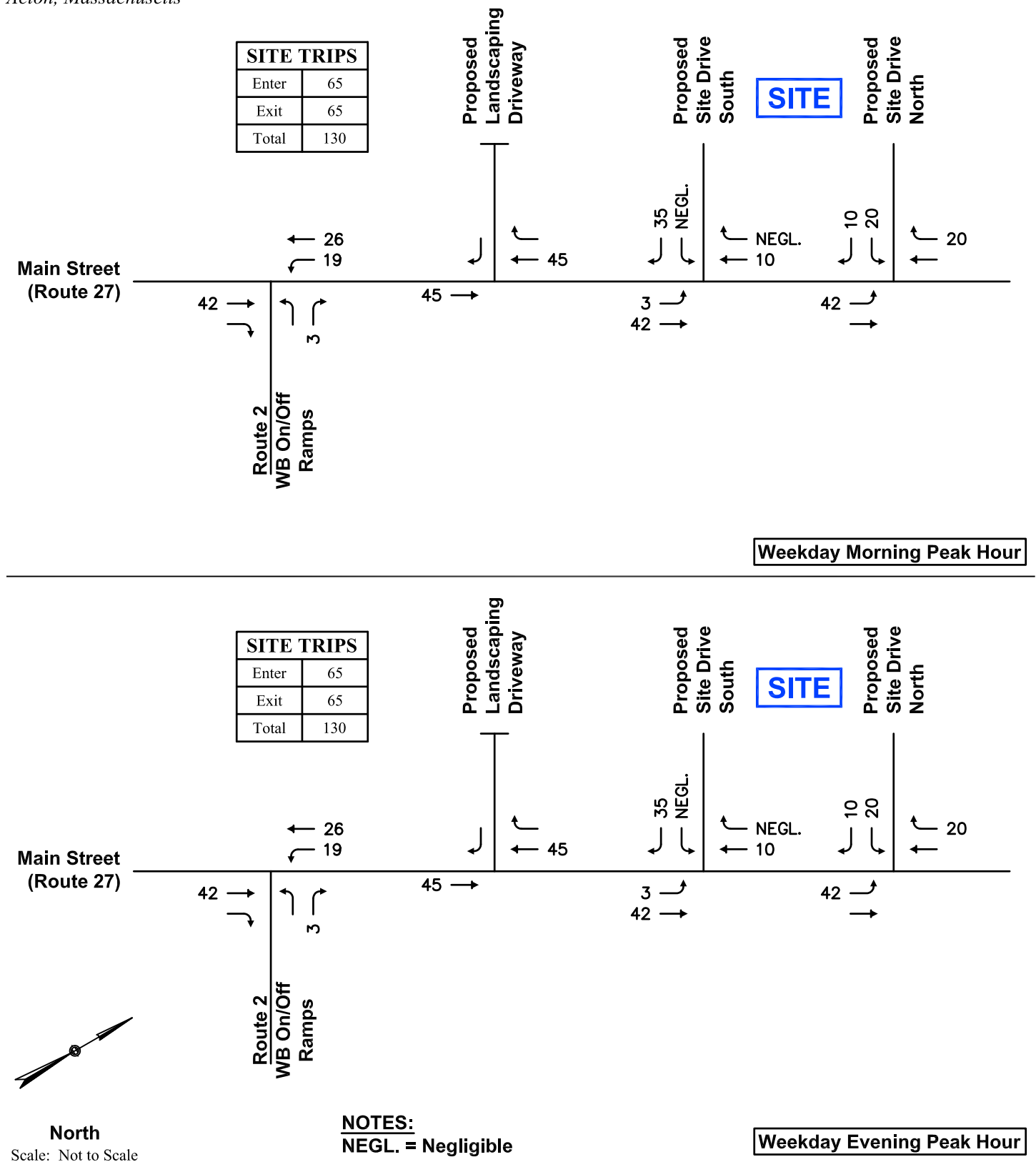


Figure 7

Site-Generated Trips
(Based on NGCC Data)

Build Traffic Volume Networks

Analysis traffic volumes are developed by adding site-generated traffic volumes presented in **Figure 6** and **Figure 7** to future No-Build traffic volumes at study intersections. Additionally, since the existing garden center use at the Site is proposed to remain but be relocated to the southern portion of the site, the reassignment of garden center trips was accounted for in the Build traffic volumes. The trip tracings for the removal of site trips from the existing location and the reassignment of trips to the proposed location are provided in the **Attachments**. The resulting Build traffic volumes used for analysis are shown in **Figure 8** and **Figure 9** for trip generation based on ITE and NGCC data, respectively.

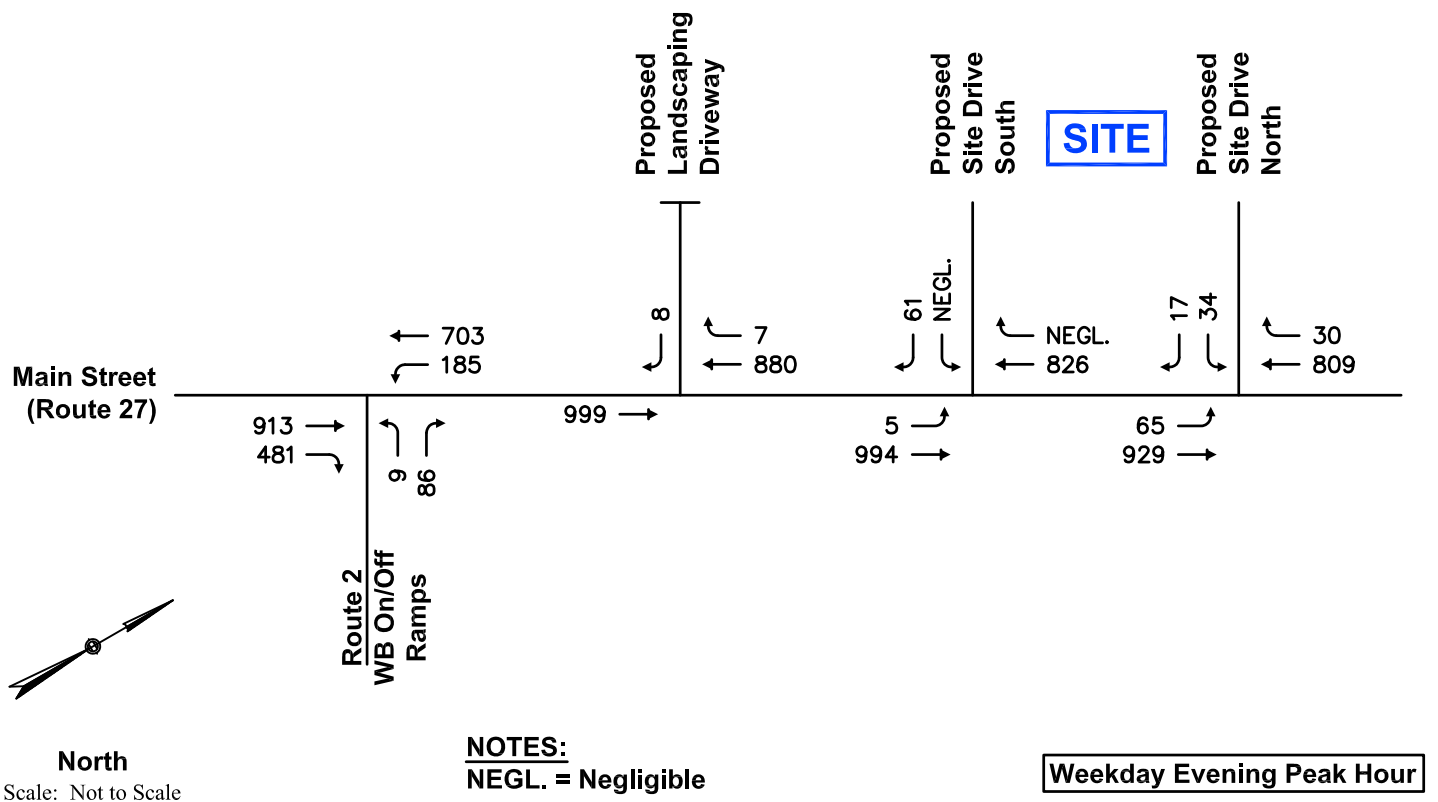
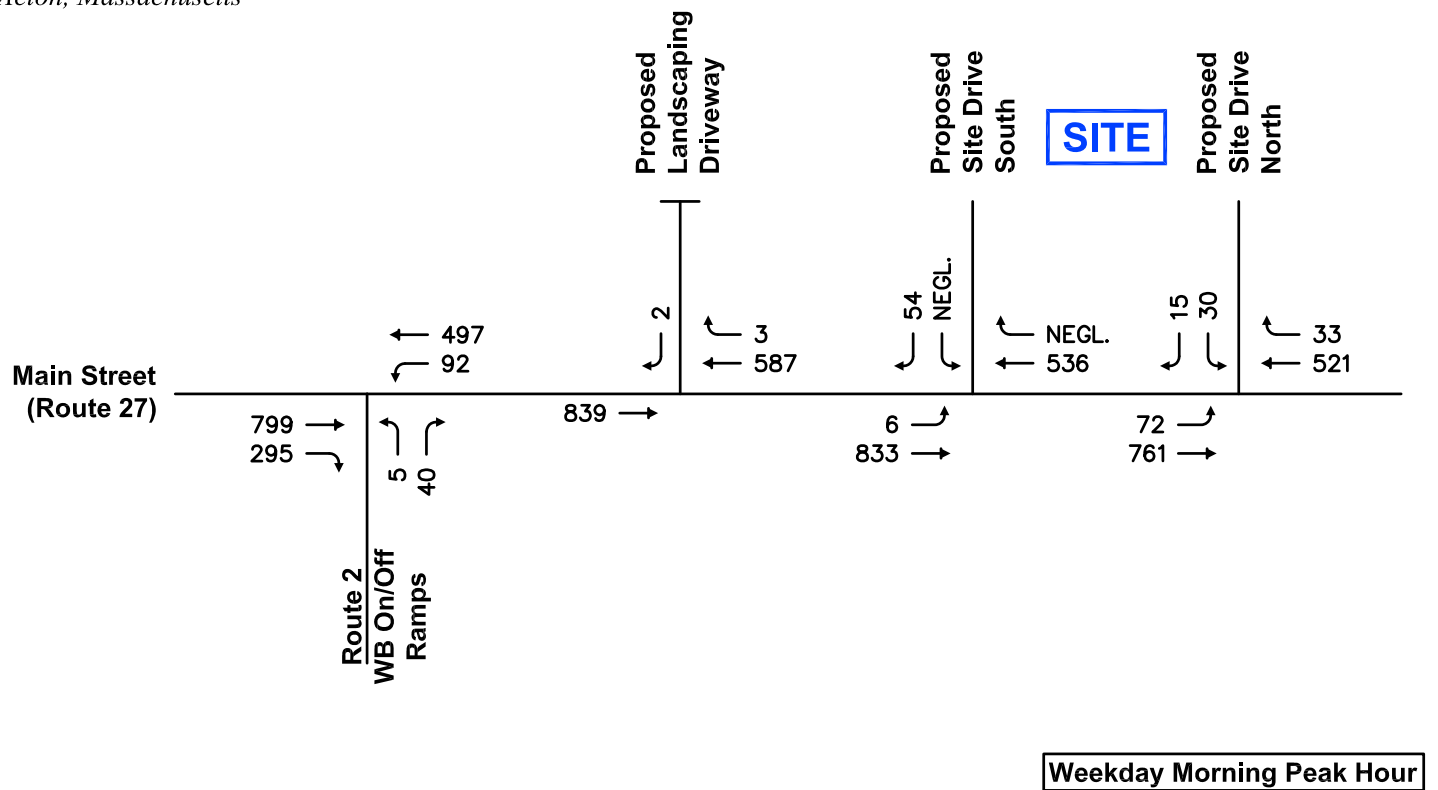
INTERSECTION OPERATIONS

Capacity Analysis Results

Intersection capacity analyses are presented in this section for the Existing, No-Build, and Build traffic-volume conditions. Capacity analyses, conducted in accordance with EOEEA/EOT guidelines, provide an index of how well the roadway facilities serve the traffic demands placed upon them. The operational results provide the basis for recommended access and roadway improvements in the following section.

Capacity analysis of intersections is developed using the Synchro® Version 6 computer software, which implements the methods of the 2010 Highway Capacity Manual (HCM). The resulting analysis presents a level-of-service (LOS) designation for individual intersection movements and (for signalized intersections) for the entire intersection. The LOS is a letter designation that provides a qualitative measure of operating conditions based on several factors including roadway geometry, speeds, ambient traffic volumes, traffic controls, and driver characteristics. Since the LOS of a traffic facility is a function of the traffic flows placed upon it, such a facility may operate at a wide range of LOS, depending on the time of day, day of week, or period of year. A range of six levels of service are defined on the basis of average delay, ranging from LOS A (the least delay) to LOS F (delays greater than 50 seconds for unsignalized movements and delays greater than 80 seconds for signalized movements). The specific control delays and associated LOS designations are presented in the **Appendix**.

LOS analyses were conducted for 2014 Existing, 2019 No-Build, and 2019 Build conditions for the study intersections. The results of the intersection capacity analyses are summarized in **Table 8**.



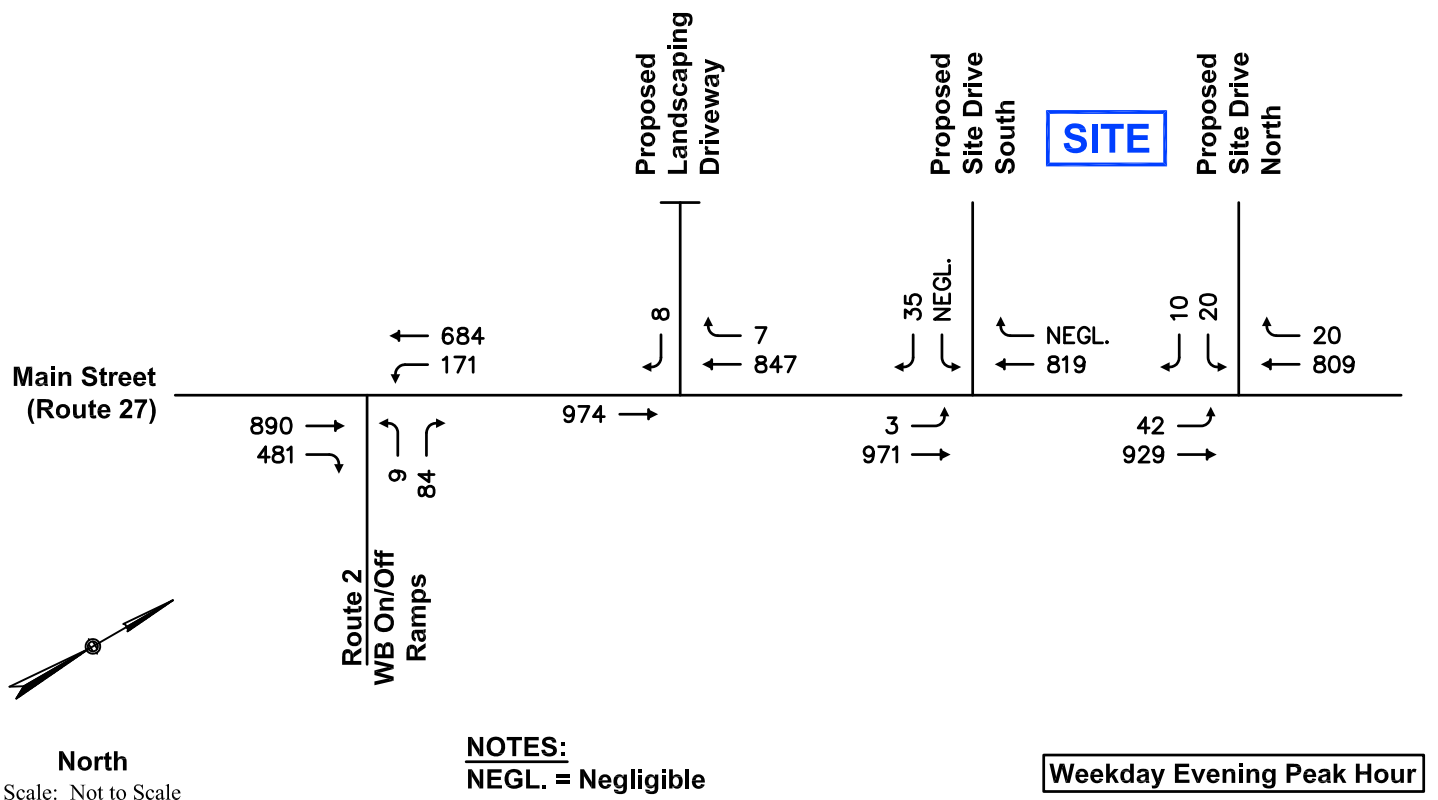
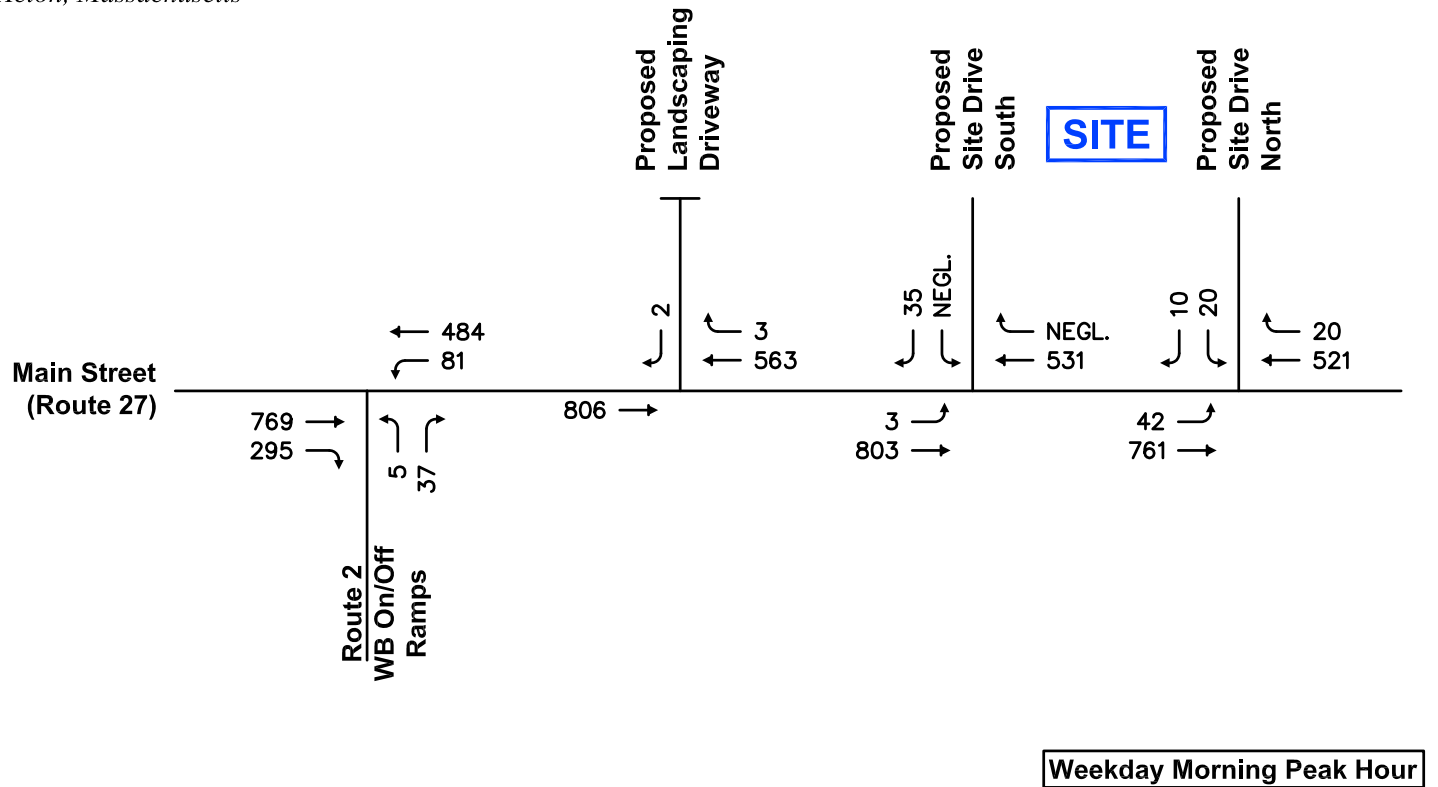


Figure 9

**2019 Build Condition
Peak Hour Traffic Volumes
(Based on NGCC Data)**

Table 8

INTERSECTION CAPACITY ANALYSIS RESULTS

Period	Approach	2014 Existing			2019 No-Build			2019 Build (Based on ITE Trip Rates)			2019 Build (Based on NGCC Data)		
		v/c ¹	Delay ²	LOS ³	v/c	Delay	LOS	v/c	Delay	LOS	v/c	Delay	LOS
Weekday Morning Peak Hour													
Main Street (Route 27) at													
Route 2 WB on/off ramps	WB Left Exit	0.03	28	D	0.04	31	D	0.05	42	E	0.05	37	E
	WB Right Exit	0.08	14	B	0.09	15	B	0.12	16	C	0.10	16	C
	Southbound	0.07	<5	A	0.08	<5	A	0.12	<5	A	0.11	<5	A
Main Street (Route 27) at													
Proposed Site Drive North	EB Left/Right Exit	n/a ⁴	n/a	n/a	n/a	n/a	n/a	0.34	43	E	0.20	32	D
	Northbound	n/a	n/a	n/a	n/a	n/a	n/a	0.08	<5	A	0.05	<5	A
Main Street (Route 27) at													
Proposed Site Drive South/Isaac Davis Way	EB Left/Right Exit	0.00	<5	A	0.00	<5	A	0.11	13	B	0.07	13	B
	Northbound	0.00	<5	A	0.00	<5	A	0.01	<5	A	0.00	<5	A
Main Street (Route 27) at													
Proposed Garden Center Driveway	EB Right Exit	n/a	n/a	n/a	n/a	n/a	n/a	0.01	13	B	0.00	12	B
Weekday Evening Peak Hour													
Main Street (Route 27) at													
Route 2 WB on/off ramps	WB Left Exit	0.13	>50	F	0.16	>50	F	0.24	>50	F	0.20	>50	F
	WB Right Exit	0.21	17	C	0.23	18	C	0.26	20	C	0.25	19	C
	Southbound	0.18	<5	A	0.20	<5	A	0.26	<5	A	0.23	<5	A
Main Street (Route 27) at													
Proposed Site Drive North	EB Left/Right Exit	n/a	n/a	n/a	n/a	n/a	n/a	0.80	>50	F	0.40	>50	F
	Northbound	n/a	n/a	n/a	n/a	n/a	n/a	0.09	<5	A	0.06	<5	A
Main Street (Route 27) at													
Proposed Site Drive South/Isaac Davis Way	EB Left/Right Exit	0.00	<5	A	0.00	<5	A	0.19	18	C	0.11	17	C
	Northbound	0.00	<5	A	0.00	<5	A	0.01	<5	A	0.00	<5	A
Main Street (Route 27) at													
Proposed Garden Center Driveway	EB Right Exit	n/a	n/a	n/a	n/a	n/a	n/a	0.03	17	C	0.03	16	C

¹Volume-to-capacity ratio²Average control delay per vehicle (in seconds)³Level of service⁴n/a = not applicable

As summarized in **Table 8**:

- *Main Street Traffic Flow.* Under future No Build and Build conditions, the mainline travel along Main Street (Route 27) at its intersections with the Route 2 Westbound Ramps and the site driveways (including Isaac Davis Way) will remain below capacity at LOS A during both the weekday morning and weekday evening peak hours.
- *Main Street at Route 2 Westbound Ramps.* Under future No Build conditions, left-turns from the Route 2 Westbound off ramp are calculated to operate at LOS D during the morning peak hour; under Build conditions this movement will experience a modest increase in traffic due to the proposed daycare, but will still operate below capacity at LOS E operations. Weekday evening peak hour conditions under both No Build and Build conditions indicate LOS F conditions; however, described in more detail in the following section, delay observations conducted at the Route 2 Westbound off ramp for this left-turn movement indicate that actual delays that are equivalent to LOS C operation. Accordingly, ample capacity is expected at this intersection to accommodate modest traffic increases associated with the proposed development.
- *Site South Driveway.* Under Build conditions, the proposed South Site Driveway at Isaac Davis Way will operate well below capacity at LOS C or better operations during the morning and evening peak hours.
- *Site North Driveway.* Traffic flow at the proposed North Site Driveway is projected to be unimpeded at LOS A on Main Street during peak hours under Build conditions. The driveway approach is projected to be at LOS E (weekday AM peak hour) and LOS F (weekday PM peak hour). The longer delay in the PM peak hour reflects delays for the modest volume of left-turn activity, ranging from approximately 20 to 34 vehicles during the evening peak hour. However, observed delays for left-turn movements along this section of Main Street also indicate that these delays are grossly exaggerated and actual delays are likely to be substantially lower. Furthermore, queue analysis also shows that the driveway will sustain a maximum (95th percentile) queue ranging from only 2 vehicles (using NGCC trip rates) and 4 vehicles (using ITE trip rates). Delays and associated queuing are attributable to left-turns exiting the North Site Driveway (approximately 1 vehicle per every two minute or less) and are expected to be entirely managed on-site with no material impact to site parking or circulation.

In summary, only modest increases in delays at the study intersections under future conditions with the project, and ample capacity is available to accommodate the daycare facility without undue impact to public travel.

Observed Intersection Delays

Field observations were made at the Main Street (Route 27) intersection with the Route 2 Westbound off ramp during the weekday morning and evening peak hours to determine actual average delays for vehicles turning left onto Main Street. The observed delay data are presented in the **Attachments**, which were used to compare actual field conditions to those calculated using Synchro® modeling presented above.

Field measurements indicated that, on average, vehicles attempting to depart from the Route 2 westbound off ramp turning left onto Main Street southbound were delayed an average of 8 seconds during the morning peak hour, results that correlate to LOS A operations and 15 seconds during the evening peak hour, results that correlate to LOS B operations. The maximum number of vehicles queued at the intersection was 2 vehicles during the morning peak hour. No vehicles were observed waiting longer than 33 seconds during the morning and evening peak hours.

When compared to the calculated delays in the capacity analysis results above, these measured average delay conditions indicate that the computer-based vehicle delay results provide an overly conservative analysis. Calculated average delays suggest the minor street approach at the Main Street and Route 2 westbound on/off ramp intersection operates at LOS D for left turning vehicles during the morning peak hour and LOS F during the weekday evening peak hour; observed average delays are significantly lower and correspond to LOS C or better for left turning vehicles. This finding suggests that ample capacity exists at the study area intersection of Main Street and Route 2 westbound on/off ramp to support the anticipated traffic generated by the Site. A comparison of calculated versus observed vehicle delays is presented in **Table 9**.

Table 9

AVERAGE VEHICLE DELAY COMPARISON

MAIN STREET (ROUTE 27) AT ROUTE 2 WB OFF-RAMP

Intersection	Calculated Delay (seconds)	LOS	Actual Delay (seconds)	LOS
<i>Weekday Morning Peak Hour</i>				
Westbound Left Turns (Stop-Control)	28	D	8	A
<i>Weekday Evening Peak Hour</i>				
Westbound Left Turns (Stop-Control)	>50	F	15	C

In summary, the proposed development is expected to have a minimal impact on the study area intersections as there will be minimal change in level of service and operations of the study intersections under future conditions with and without the development, with no increase in left-turning traffic on the Route 2 westbound off ramp. In general, adequate capacity is available under future Build conditions to accommodate the site use.

CONCLUSIONS AND RECOMMENDATIONS

In summary, adequate capacity is available along Main Street (Route 27) to accommodate projected traffic increases for the proposed development under the proposed 2011 Site Plan. Observed delays for the left-turns from the Route 2 westbound off ramp intersection with Main Street indicated that LOS C or better conditions exist for this critical movement, and that ample capacity will be available to accommodate NGCC trips. Based on observed delay at the critical intersection ample capacity exists in the study area to accommodate the project. These findings are consistent with those reported in the July 2008 TIA, which also documents impacts at the Main Street and Route 2 Eastbound Ramp intersection with similar conclusions.

Safe stopping sight distance (SSD) is available for oncoming vehicles to detect, react and stop for vehicles exiting onto Main Street (Route 27) from the Site driveways based on the regulatory speed limit and observed average and 85th percentile travel speeds. Likewise, ample sight lines will be available for the proposed Site plan to meet or exceed applicable Intersection Sight Distance (ISD) requirements based on ambient 85th percentile travel speeds. MDM recommends that plantings (shrubs, bushes) and structures (walls, fences, etc.) be maintained at a height of 2 feet or less within the Main Street (Route 27) layout in the vicinity of the site driveways to provide unobstructed sight lines.